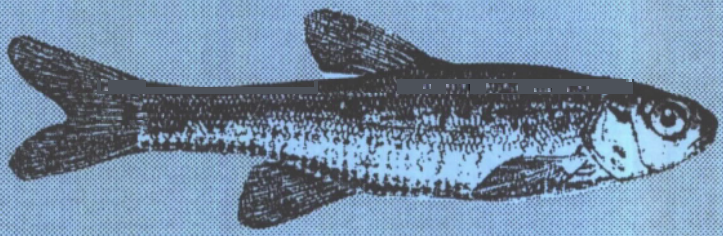
BIG SPRING SPINEDACE RECOVERY PLAN



U. S. Fish and Wildlife Service
Portland, Oregon

BIG SPRING SPINEDACE

(*Lepidomeda mollispinis pratensis*)

RECOVERY PLAN

U.S. Fish and Wildlife Service
Region 1
Portland, Oregon

Approved: Don Weathers
Acting Regional Director

Date: 1/20/94

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ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY OF THE BIG SPRING SPINEDACE RECOVERY PLAN

Current Status: Big Spring spinedace, a federally threatened species, occurs in an 8-kilometer section of Meadow Valley Wash in Condor Canyon, north of Panaca, Lincoln County, Nevada. The species has been extirpated from its type locality, the outflow stream from Panaca (Big) Spring, which historically connected with Meadow Valley Wash just below Condor Canyon. The remnant population is vulnerable to catastrophic events, adverse habitat modification, and nonnative species introductions. Big Spring spinedace are relatively abundant within Condor Canyon, although actual population size has not been determined.

Habitat Requirements and Limiting Factors: Big Spring spinedace life history and habitat requirements and limiting factors are poorly understood.

Recovery Objective: Delist

Recovery Criteria: Big Spring spinedace may be proposed for delisting when a self-sustaining population exists in Meadow Valley Wash at Condor Canyon for at least 5 consecutive years and its habitat is secured from all known threats. Recovery efforts should include restoration of habitat between Condor Canyon and Panaca Spring to allow the Big Spring spinedace population to expand into its historic habitat. Additionally, one or more self-sustaining refugia populations of Big Spring spinedace should be established to prevent the extinction of the species should unforeseen catastrophic events severely impact or eliminate the Condor Canyon population.

Actions Needed:

1. Secure Big Spring spinedace habitat in Condor Canyon by obtaining conservation agreements with private landowners and instream flow water rights.
2. Monitor Big Spring spinedace population in Condor Canyon.
3. Establish Big Spring spinedace refugium population.
4. Enhance Big Spring spinedace population in Condor Canyon.
5. Enhance Big Spring spinedace habitat in Condor Canyon.
6. Implement public outreach program.

Total Estimated Cost of Recovery ($1,000's):

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Need 6	Total
1994	4	3	12	5	15	5	44
1995	4	0	12	11	15	4	46
1996	0	0	12	8	12	0	32
1997	0	0	4	10	2	0	16
1998	4	0	4	0	5	0	13
1999	4	0	13	0	8	0	25
2000	0	0	3	0	5	0	8
2001	0	0	0	0	2	0	2
2002	0	0	0	0	2	0	2
2003	0	0	0	0	2	0	2
2004	0	0	0	0	2	0	2
2005	0	0	0	0	2	0	2
2006	0	0	0	0	2	0	2
Total:	16	3	60	34	74	9	196

Date of Recovery: Delisting of the Big Spring spinedace should be initiated in 2006, if recovery criteria are met.

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Part I. INTRODUCTION

A. Brief Overview

Big Spring spinedace (*Lepidomeda mollispinis pratensis*), listed as a federally threatened species in March 1985 (50 Federal Register 12298), is one of three native fishes occupying the stream habitat of Meadow Valley Wash in Lincoln County, Nevada. Big Spring spinedace are restricted to an 8-kilometer section of stream which flows through private and public lands in Condor Canyon north of Panaca, Nevada. Meadow Valley Wash desert sucker (*Catostomus clarki* ssp.) and Meadow Valley Wash speckled dace (*Rhinichthys osculus* ssp.), however, occur throughout the approximately 195-kilometer-long drainage in areas of perennial water. Big Spring spinedace have been extirpated from the Panaca (Big) Spring outflow stream, which flows into Meadow Valley Wash below Condor Canyon, due to habitat modification and nonnative species introductions.

Big Spring spinedace are relatively abundant within Condor Canyon, although actual population size is unknown. Because only one population is known to exist, this species is vulnerable to catastrophic events, human-induced habitat modifications, and nonnative species

introductions. Any reduction in Big Spring spinedace population density or distribution, loss or modification of occupied habitat, or increased threats could warrant changing the species' status to endangered.

When implemented, the tasks recommended in this recovery plan, although specifically addressing the needs of Big Spring spinedace, should enhance the aquatic ecosystem of the Condor Canyon reach of Meadow Valley Wash and promote the conservation of all endemic aquatic species supported therein. Meadow Valley Wash desert sucker and Meadow Valley Wash speckled dace are category 2 candidates for possible future listing as threatened or endangered species under the Endangered Species Act of 1973, as amended (Act) (56 Federal Register 58804). The U.S. Fish and Wildlife Service (Service) has information indicating that proposing to list these fishes is possibly appropriate, but substantial data on biological vulnerability and threat(s) are not currently available to support preparation of a proposed rule. Consideration of these candidate species and all other endemic aquatic species during Big Spring spinedace recovery activities could alleviate the need to list these species as threatened or endangered species in the future.

B. Species Description

The Plagopterini tribe of cyprinid fishes includes the monotypic genera *Meda* (spikedace) and *Plagopterus* (woundfin), and the polytypic genus *Lepidomeda* (spinedace) (Table 1). Members of this tribe are distinguished from other cyprinids by: 1) The spinelike character of the pelvic and pectoral fin rays and the two anterior dorsal fin rays; 2) a membranous connection between the innermost ray of the pelvic

Table 1: Members of the Plagopterini tribe of cyprinid fishes, as described by Miller and Hubbs (1960), with their Federal status and historic distribution.

Common Name, Scientific Name
Status*
Distribution

Spikedace, *Meda fulgida*
Threatened
- Gila River system; Arizona, New Mexico

Woundfin, *Plagopterus argentissimus*
Endangered
- Virgin River system; Utah, Arizona, Nevada
- lower Gila River system; Arizona (extirpated)

Little Colorado spinedace, *Lepidomeda vittata*
Threatened
- headwaters Little Colorado River system; Arizona

Pahranagat spinedace, *Lepidomeda altivelis*
Extinct
- Ash Spring outflow and Upper Pahranagat Lake; Lincoln County, Nevada (extirpated)

White River spinedace, *Lepidomeda albivallis*
Endangered
- Flag Springs; Nye County, Nevada
- Preston Big Spring, Indian Spring, Nicholas Spring, Arnoldson Spring, Cold Spring, Lund Spring, and the upper White River; White Pine County, Nevada (extirpated)

Lower Colorado spinedace, *Lepidomeda mollispinis*

Virgin River spinedace, *Lepidomeda m. mollispinis*
Candidate Category 2
(Petition to list as an endangered species received by the Service in July 1992; 58 Federal Register 14169)
- Virgin River system; Utah, Arizona, Nevada

Big Spring spinedace, *Lepidomeda m. pratensis*
Threatened
- Meadow Valley Wash (Condor Canyon section); Lincoln County, Nevada
- Big Spring outflow; Lincoln County, Nevada (extirpated)

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*as listed in 50 CFR 17.11 and 17.11, August 29, 1992; or 56 Federal Register 58804, November 21, 1991.

fins and the belly; 3) bright silver coloration; and 4) the absence or diminutive development of body scales (Miller and Hubbs 1960). Plagopterin fishes are among the few North American cyprinids that are not known to hybridize with other genera (Hubbs 1955).

Spinedace are the most generalized and diverse of the plagopterin genera and presumably gave rise to the more specialized spikedace and woundfin (Miller and Hubbs 1960; Uyeno and Miller 1973). Spinedace have weakly developed dorsal and pectoral fin spines compared to the strongly developed spines of spikedace and woundfin. Spinedace also possess diminutive scales, whereas spikedace and woundfin are scaleless (Miller and Hubbs 1960).

Big Spring spinedace were described by Miller and Hubbs (1960) following a review of the previous classification of the genus *Lepidomeda*. Three new species of spinedace, one with two subspecies, were identified and the two previously recognized spinedace species were synonymized into one. The Middle Colorado spinedace (*Lepidomeda mollispinis*) are distinguished by: 1) A pharyngeal tooth formula of 5-4 in the main row; 2) a relatively weak and soft-tipped second dorsal spine; 3) nine anal rays; 4) typically less than 90 scales in the lateral line; 5) length of the dorsal fin when depressed is less than head length; 6) sides of the body mostly silvery; and 7) melanophores confined to the upper half of the opercle and to the upper part of the ascending limb of the preopercle (Miller and Hubbs 1960). Big Spring spinedace are differentiated from Virgin River spinedace (*Lepidomeda mollispinis mollispinis*) by a higher, more pointed dorsal fin; longer pelvic fins; and a smaller, more oblique mouth (Miller and Hubbs 1960). Big Spring spinedace's subspecific

epithet, *pratensis*, means "pertaining to or growing in a meadow" (Miller and Hubbs 1960).

Big Spring spinedace are bright silver in color, with some individuals having yellow-to-orange at the axils of paired fins, base of the anal fin, upper edge of the shoulder girdle, vertical arm of the preopercular bone, and above the mouth. Specimens collected from the outflow of Big Spring in 1938 ranged from 48 to 56 millimeters total length (Miller and Hubbs 1960). Big Spring spinedace captured from Meadow Valley Wash in Condor Canyon varied from 48 to 93 millimeters total length (Allan 1985). Two male Big Spring spinedace collected from within Condor Canyon in 1986 exceeded 110 millimeters total length (Withers 1986).

C. Historic Distribution and Current Population Status

All members of the Plagopterini tribe historically occupied highly localized habitats within the Colorado River drainage system of Arizona, New Mexico, Nevada, and Utah. Human manipulation of these habitats and introductions of nonnative fish species (those species not indigenous to the drainage system) further reduced each species' restricted distribution and caused severe population declines (Miller 1961). Within this tribe, one species is extinct and five species or subspecies are federally listed as threatened or endangered species (Table 1). In July 1992, the Service was petitioned to list the remaining subspecies as an endangered species (58 Federal Register 14169).

Big Spring spinedace were first collected from the outflow stream of Panaca Spring and its adjacent wet meadow near Panaca, Nevada in

1938 (Figure 1) (Miller and Hubbs 1960). At that time, a prolonged seining effort produced only 7 Big Spring spinedace, but 31 Meadow Valley Wash desert suckers and 312 Meadow Valley Wash speckled dace. Big Spring spinedace were not found in the Panaca Spring pool. By 1959, Big Spring spinedace had been extirpated from the Panaca Spring habitat and the species was considered extinct before it was even taxonomically described (Miller and Hubbs 1960). Field studies conducted during 1938 and 1959 discovered no additional populations of Big Spring spinedace, although selected sites along 160 kilometers of the Meadow Valley Wash drainage, above and below Panaca Spring, were examined. Meadow Valley Wash desert suckers and Meadow Valley Wash speckled dace were the only native fish species collected. The reports from surveys conducted during 1938 and 1959 suggest, however, that Meadow Valley Wash through Condor Canyon was not inventoried at that time (Miller and Hubbs 1960).

In 1977, Big Spring spinedace were discovered in the plunge pool beneath a 15-meter waterfall in Condor Canyon, approximately 6 kilometers north of Panaca Spring (Allan 1983). In 1980, larval Big Spring spinedace were transplanted from the waterfall plunge pool to small, instream pools 1.5 kilometers above the waterfall. Adult Big Spring spinedace were collected from the transplant site during the spring of 1981 (Allan 1985). It is not known if Big Spring spinedace occurred above the waterfall prior to the 1980 transplant.

During 1984, five sites within Condor Canyon were sampled, but Big Spring spinedace were present only at the transplant site (Allan 1985). Meadow Valley Wash desert suckers and Meadow Valley Wash speckled dace were present at all sites. In May 1986,

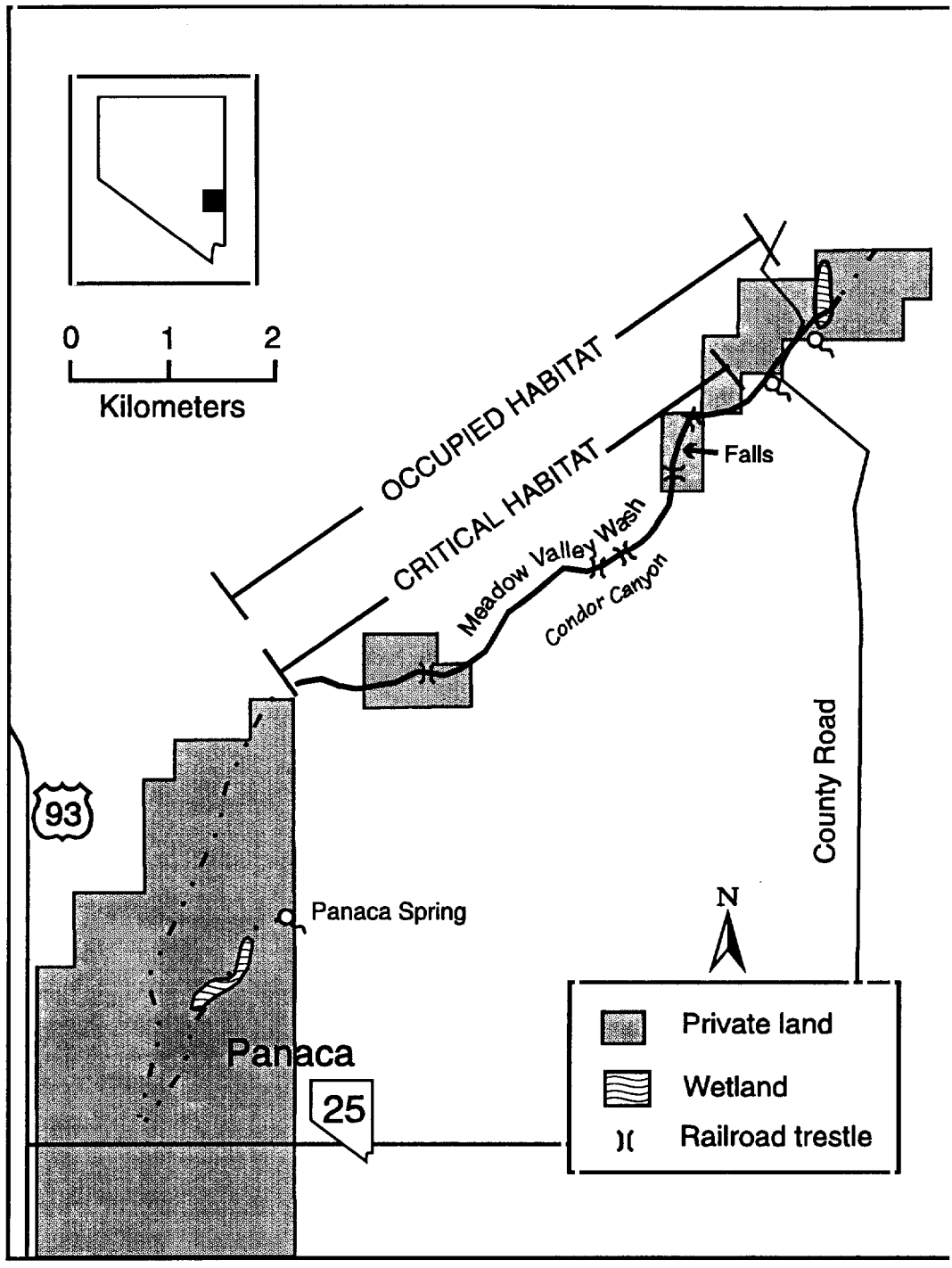

Figure 1. Big Spring spinedace historic habitat (Panaca Spring outflow stream), designated critical habitat, and currently occupied habitat in Meadow Valley Wash, near Panaca, Lincoln County, Nevada.

however, a total of 204 Big Spring spinedace were collected from 11 of 15 sites sampled along approximately 7 kilometers of Meadow Valley Wash, above and within Condor Canyon (Withers 1986). Big Spring spinedace were most abundant in and near the transplant site, where 97 individuals were captured. Meadow Valley Wash desert suckers and Meadow Valley Wash speckled dace were present throughout the canyon. A total of 546 Big Spring spinedace were captured from 13 sample sites within Condor Canyon during November 1990 (Langhorst 1991).

D. Critical Habitat

Critical habitat, as defined by section 3 of the Act includes: 1) the specific areas, within the geographical area occupied by a species at the time of its listing under the Act, which contain those physical or biological features essential to the conservation of the species and which may require special management considerations or protection; and 2) specific areas outside the geographical area occupied by the species at the time it is listed which are determined to be essential for the conservation of the species.

Big Spring spinedace critical habitat (50 Federal Register 12298) encompasses 6.4 kilometers of Meadow Valley Wash and a 15-meter riparian zone along each side of the stream as it flows through Condor Canyon within T. 1 S., R. 68 E., sections 13, 23, 24, 26, 27, and 28 (Figure 1). Critical habitat begins at the north end of the canyon and continues downstream to the terminus of the canyon. Critical habitat does not include all stream habitat currently or historically occupied by Big Spring spinedace. The primary known constituent elements of Big Spring spinedace critical habitat include: 1) Clean, permanent,

flowing, spring-fed stream habitat with deep pool areas and shallow marshy areas along the shore; and 2) the absence of nonnative fishes.

E. Life History and Habitat Requirements

Big Spring spinedace life history and habitat requirements are poorly understood. What little information is available comes from field observations made during collecting efforts or status surveys. Preliminary data have been collected by the University of Nevada, Las Vegas, but a final report has not yet been prepared.

Big Spring spinedace collected in 1938 occupied the outflow stream and associated marsh areas below Big Spring, but not the spring pool (Miller and Hubbs 1960). On July 10, 1938, with an air temperature of 35° Centigrade (C), water temperature of the stream within the meadow was 29° C in a channel 0.3 to 1 meter wide and up to 0.6 meter deep. The current was slight over most of the stream course, but occasionally swift. Stream bottom substrate consisted of firm to soft clay with some gravel. Aquatic vegetation included watercress (*Rorippa*), pondweed (*Potamageton*), and rushes (*Scirpus*). By 1959, when the Big Spring spinedace was reported extirpated from Panaca Spring, the spring outflow stream was clogged with silt and a variety of submergent and emergent vegetation, conditions which had not been present in 1938 (Miller and Hubbs 1960).

Panaca Spring discharged 23.9 cubic meters per minute (m^3/m) at 31° C in 1946, but dropped to 18.6 m^3/m at 30° C by 1963 (Garside and Schilling 1979). Spring discharge continued to decrease, such that between 1989 and 1990 it varied from a low of 0.7 m^3/m in November to a high of 3.0 m^3/m in March (Pupacko, et al. 1989;

Bostic, et al. 1990; Garcia, et al. 1991; Hess, et al. 1992). Historically, Panaca Spring's outflow stream was tributary to Meadow Valley Wash below Condor Canyon, but all water is now captured for primarily agricultural purposes.

Meadow Valley Wash flows through Condor Canyon as a small perennial stream which depends on spring discharge to maintain its volume. Delmue Springs, just above the northern end of Condor Canyon, provides a base flow of approximately 0.8 m^3/m (Garside and Schilling 1979). Above Delmue Springs, Meadow Valley Wash is intermittent and interrupted by two reservoirs. Additional springs within Condor Canyon add to the stream's total volume. Flow measurements taken during a 1987 aquatic inventory of Condor Canyon ranged from 3.8 m^3/m to 11.8 m^3/m (Bureau of Land Management 1990). The stream is well confined within steep rock and soil formations, often moderately to deeply entrenched, and averages 2.7 meters wide and 0.2 meter deep with an average gradient of 1.6 percent (Bureau of Land Management 1990). The stream course within Condor Canyon was altered near the waterfall during construction of the Union Pacific Railroad Company track.

Big Spring spinedace collected in Condor Canyon in 1981 and 1984 were found in areas 0.3 to 1 meter deep, with moderate to slow currents, undercut banks, and floating aquatic vegetation (Allan 1985). Big Spring spinedace spawning behavior has never been observed, and spawning habitat requirements are unknown. Juvenile Big Spring spinedace (15 millimeters total length) were observed in Condor Canyon in September 1980 (Allan 1985). Langhorst (1991) reported that 18 of 39 Big Spring spinedace collected during late May 1990 exhibited some form of spawning condition, such as

tuberculation on the head or orange coloration on the paired fins. No spawning activity or young-of-the-year Big Spring spinedace were observed. By early July 1990, 1 of 14 Big Spring spinedace collected exhibited spawning condition, but young-of-the-year Big Spring spinedace were collected from dense watercress patches along the stream banks. Less than 1 percent of 241 Big Spring spinedace collected during the first week of August 1990 exhibited spawning conditions, but young-of-the-year Big Spring spinedace (average 37 millimeters total length) were common.

Big Spring spinedace food preferences and feeding habits are unknown. The closely-related Virgin River spinedace are opportunistic drift-feeders, feeding primarily on aquatic insect larvae but consuming algae and other plant material when insects are scarce (Rinne 1971, Minckley 1973). Allan (1985) suggested that vegetation, especially watercress, is important in providing habitat for aquatic insect and invertebrate foods for Big Spring spinedace.

The extant population of Big Spring spinedace in Condor Canyon has not been genetically compared to preserved specimens collected from the Big Spring outflow stream in 1938. Preliminary genetic studies conducted by the Arizona State University (ASU) suggest that there is no difference between the populations above and below the waterfall (Paul Marsh, ASU, pers. comm., July 1993).

No information is available regarding the life history and habitat requirements of Meadow Valley Wash desert suckers, Meadow Valley Wash speckled dace, or any other native species, or how these species interact with the Big Spring spinedace. This information should be obtained to ensure that any recovery activity implemented

to benefit Big Spring spinedace does not inadvertently impact another native species.

F. Reasons for Decline and Current Threats

The Service determined the Big Spring spinedace to be a threatened species and designated its critical habitat on March 28, 1985 (50 Federal Register 12298) because one population had been eliminated and the remaining population was potentially threatened by habitat alteration and introduction of nonnative species. In addition, the limited distribution of the extant population in Condor Canyon makes the Big Spring spinedace vulnerable to extirpation from a catastrophic event which severely modifies the species habitat. The Service determined that threatened status was appropriate for this subspecies because it was in no immediate danger of extinction, but was likely to become endangered if trends in population declines and habitat alteration continued.

Miller and Hubbs (1960) attributed the eradication of Big Spring spinedace and Meadow Valley Wash desert suckers from the outflow stream from Panaca Spring to the introduction of nonnative species, the diversion of water, and occasional desiccation of both the original outflow and the diversion ditch. By 1959, Big Spring had been dammed and a ditch constructed to divert the spring outflow for irrigation. The abandoned natural channel had become clogged with silt and vegetation. Intensive and thorough seining of all remaining open water in 1959 revealed large concentrations of Meadow Valley Wash speckled dace but no other native fishes. The nonnative mosquitofish (*Gambusia affinis*) had become firmly established, and

nonnative bullfrogs (*Rana catesbiana*) greatly outnumbered the native leopard frog (*Rana pipens*) (Miller and Hubbs 1960).

Because of the limited distribution of Big Spring spinedace, the species is vulnerable to events which may severely reduce or extirpate the population within Condor Canyon. Several potential threats to the population have been identified. At the time the Big Spring spinedace was listed as a threatened species, nonnative species were not known to occur in the Condor Canyon section of Meadow Valley Wash. Since then, an unidentified nonnative crayfish has become established throughout Condor Canyon, and limited numbers of largemouth bass (*Micropterus salmoides*), rainbow trout (*Oncorhynchus mykiss*), and white crappie (*Poxomis annularis*) have been collected in Condor Canyon (Withers 1986, 1987a, 1987b, 1988). There is no indication that the nonnative fishes have become established. Nonnative aquatic species may be detrimental to the native fishes due to predation, competition for available resources, and transmission of parasites or diseases.

Meadow Valley Wash crosses both private land and public land managed by the Bureau of Land Management (BLM). Within Condor Canyon, property boundary fences have been constructed with corners located on or in close proximity to the stream. These fences may concentrate livestock use within the riparian corridor and result in degraded aquatic habitat. Cooperation of the private landowners will be essential to long-term maintenance of the riparian corridor.

In 1984, the Union Pacific Railroad removed the tracks from its railway that passed through Condor Canyon. Although the railroad tracks were removed, the trestles and railroad bed were left intact,

creating a road through the canyon where none had been previously. Because the Union Pacific Railroad has not formally abandoned its 60-meter-wide right-of-way through Condor Canyon, it is still responsible for the right-of-way. BLM cannot impose management on the right-of-way until it is formally relinquished back to the Federal government (BLM 1990).

Public use of the canyon has significantly increased since the railroad tracks were removed. The riparian habitat of Condor Canyon has been impacted by vehicle use off the railroad bed and from tree cutting. Two railroad trestles have been destroyed by suspected arson fires. The effect of these fires on the aquatic environment has not been evaluated. Easy access into the canyon also increases the risk of nonnative species introductions and release of toxic substances into the stream.

Three valid mining claims exist in the immediate vicinity of Condor Canyon and overlap with Big Spring spinedace critical habitat. These claims are presently inactive, and the exact locations of the work sites are unknown (BLM 1990). The stream channel in the lower end of Condor Canyon has been severely modified with a bulldozer. No reason for this activity could be determined, other than it may have been an attempt to create a crossing for the bulldozer, which was too large to cross a nearby trestle, to provide access to a mining claim.

Because maintenance of adequate water flow in Meadow Valley Wash through Condor Canyon depends on adequate spring flow, future ground water depletion due to development of water wells within the ground water system supporting the Condor Canyon springs could adversely affect the aquatic ecosystem. Due to the nature of the

canyon, diversion of water from the stream channel is not feasible. Four water rights have been granted by the Nevada State Water Engineer for Meadow Valley Wash water at Condor Canyon. One is an instream flow right, reserved for Big Spring spinedace; the remaining three are for irrigation of private lands below the south end of the canyon. Irrigation water is diverted from the stream at the southern end of the canyon.

G. Conservation Efforts

The final rule determining the Big Spring spinedace to be a federally threatened species included a special rule allowing take of Big Spring spinedace for scientific purposes in accordance with State laws and regulations (50 Federal Register 12298). The Nevada Board of Wildlife Commissioners recognizes the Big Spring spinedace as a protected species and prohibits collection of it without a valid State collecting permit (Nevada Revised Statutes 503.065).

Conservation efforts for the Big Spring spinedace have been ongoing since the subspecies was rediscovered. The Nature Conservancy purchased 16 hectares in Condor Canyon in December 1981. This property includes 0.25 kilometer of Big Spring spinedace habitat. The Nature Conservancy was also granted an instream flow water right of 3.1 m^3/m, which applies to the stream through the entire length of Condor Canyon to the point of diversion for the other water rights. This water right was based on measured flow during low-flow conditions in midsummer.

BLM began a thorough inventory of the aquatic habitat and associated riparian zone within Condor Canyon in 1987. This effort included

implementation of stream survey and riparian transect methodology, an aerial infrared photographic survey, water quality monitoring, and a botanical inventory. BLM contracted the University of Nevada, Las Vegas and The Nature Conservancy to monitor water quality and to conduct a botanical inventory, respectively. The botanical inventory found a high diversity of vegetative species within both the riparian and upland communities (BLM 1990). These inventories will provide a baseline for comparison of future habitat conditions.

In July 1987, 75 Big Spring spinedace were released into a pond within BLM's Shoshone Pond Resource Area in White Pine County (Withers 1987b). This transplant was undertaken as an emergency protective measure after largemouth bass were found in Big Spring spinedace habitat. Although six adult Big Spring spinedace were captured from Shoshone Ponds in August 1989, none were captured or observed in July 1991 (Sjoberg 1989, Heinrich 1991).

In 1989, NDOW issued a contract for a study of the population status and habitat preferences of the Big Spring spinedace. This study was partially funded by the Service through section 6 of the Act. All field work has been completed, but the final project report is still pending.

BLM published the Condor Canyon Habitat Management Plan (HMP) in 1990. This HMP is designed to maintain or improve habitat conditions for Big Spring spinedace and includes objectives to enhance the quality and quantity of habitat elements needed by Big Spring spinedace. BLM recognizes that the continued existence of Big Spring spinedace depends on maintaining the Condor Canyon ecosystem. The HMP identifies BLM's intent to: 1) Exclude livestock grazing within Condor Canyon between March 15 and November 15

and limit allowable vegetation utilization; 2) limit casual vehicle use to the railroad bed and prohibit organized competitive or non-competitive vehicle events; 3) file for unappropriated spring water and instream flow rights; and 4) install stream flow gauging stations (BLM 1990).

BLM consulted with the Service prior to authorizing actions which may have affected the Big Spring spinedace, including livestock grazing, the HMP, and equestrian endurance rides. The Federal Highway Administration, through the Nevada Department of Transportation, consulted with the Service prior to authorizing the use of Federal cost-share monies to replace the Delmue Bridge, which crosses the Meadow Valley Wash above the north end of Condor Canyon.

In August 1993, the Service and The Nature Conservancy entered into a cooperative agreement to conserve and restore biological diversity in six areas in Nevada. The goal of the first project is to eliminate nonnative plant species from Condor Canyon to aid in restoring the riparian ecosystem.

Part II. RECOVERY

A. Objective

The objective of the Big Spring Spinedace Recovery Plan is to improve the species' status so that it may be removed from the Federal list of endangered and threatened species. Big Spring spinedace may be proposed for delisting when a self-sustaining population exists in Meadow Valley Wash at Condor Canyon for at least 5 consecutive years and its habitat is secured from all known threats. Historic accounts suggest that this species was naturally restricted to a single population within Meadow Valley Wash and its tributary spring outflow streams in the vicinity of Panaca, Nevada. Recovery efforts should include protection of the population in Condor Canyon and restoration of habitat between Condor Canyon and Panaca Spring to allow Big Spring spinedace to expand into historic habitat. Additionally, one or more self-sustaining refugia populations of Big Spring spinedace should be established to prevent the extinction of the species should unforeseen catastrophic events severely impact or eliminate the Condor Canyon population.

Specific information on Big Spring spinedace life history and habitat requirements is necessary to determine the characteristics of a self-sustaining Big Spring spinedace population and the extent of habitat needed to support it. Recovery of Big Spring spinedace will be accomplished with full consideration given to the needs of the Meadow Valley Wash desert sucker, Meadow Valley Wash speckled dace, and all other endemic aquatic species, such that actions taken

to improve the status of Big Spring spinedace should also improve the long-term status of the entire aquatic ecosystem.

The recovery criteria are preliminary and may be revised on the basis of new information, including that obtained from research specified as recovery tasks in this plan. Prior to implementation of any task recommended in this recovery plan, the lead agency must comply with all applicable provisions of the National Environmental Policy Act and the Endangered Species Act of 1973, as amended.

B. Narrative

1. Secure, enhance, and maintain the Big Spring spinedace population

Recovery of Big Spring spinedace requires protecting the existing population and its habitat in Meadow Valley Wash at Condor Canyon and eliminating or minimizing known threats and limiting factors so that the population can maintain itself into the future. Insufficient information on Big Spring spinedace life history and habitat requirements is currently available to guide recovery activities, so research will be necessary.

1.1. Identify Big Spring spinedace essential habitat

The extent and characteristics of habitat necessary to support a self-sustaining population of Big Spring spinedace should be identified. This habitat may extend beyond the limits of designated critical habitat; if so, its protection and management may be essential to the recovery of Big Spring spinedace.

1.1.1. Determine Big Spring spinedace life history and habitat requirements

Data specific to Big Spring spinedace habitat and feeding requirements, reproductive behavior, and demographic parameters such as reproductive rates, age structure, and population growth rates need to be acquired. Research efforts should also identify minimum instream flow requirements for this species and determine if the current instream flow water right granted to The Nature Conservancy for conservation of Big Spring spinedace is sufficient to support the species. This information will form the basis on which to identify any factors which may

be limiting the Big Spring spinedace population in Condor Canyon and develop plans to restore the outflow stream at Panaca Spring and establish refugia populations.

1.1.2. Determine species interactions

Caution should be exercised to avoid implementing management actions which benefit Big Spring spinedace at the expense of any cohabiting native species. Determination of life history and habitat requirements, including minimum instream flow, of Meadow Valley Wash desert sucker and Meadow Valley Wash speckled dace may be necessary to identify possible conflicts. Behavioral observations among native species may be necessary to determine the influence of interspecific interactions on community structure. Such information may also be important with regard to expansion of the Condor Canyon population and establishment of Big Spring spinedace refugia populations. Removal and/or control of nonnative species, without detrimental effects to native fish populations, will be facilitated by an understanding of the life history and habitat requirements of the nonnative species and interactions between native and nonnative species.

1.1.3. Conduct population viability analysis

A population viability analysis should be conducted to estimate the parameters of a self-sustaining Big Spring spinedace population and the amount of habitat necessary to maintain such a population. This information should be used to evaluate the current status of the Condor Canyon

population of Big Spring spinedace and to guide recovery efforts. This information should also be used to facilitate efforts to establish self-sustaining refugia populations of Big Spring spinedace.

1.1.4. Determine the components of the Condor Canyon stream ecosystem

All components of a stream ecosystem, from the flood plain to the stream bottom, are functionally integrated. Each of these components and their interactions need to be understood, especially in relation to energy flow, nutrient cycling, and food webs, to provide the proper context for protection and recovery of the Big Spring spinedace. It is also important to understand how alterations to the various components impact the geomorphology of the stream, the integration of the ecosystem, and availability of Big Spring spinedace habitat.

1.2. Secure Big Spring spinedace essential habitat

The stated objective of this recovery plan includes securing Big Spring spinedace habitat from all known threats. Efforts should be undertaken to ensure that all habitat determined to be essential to the recovery of Big Spring spinedace is managed for the benefit of the species and protected from adverse habitat modifications and nonnative species introductions.

1.2.1. Obtain conservation agreements with private landowners

Continuous and consistent protection of Big Spring spinedace essential habitat at Condor Canyon requires

securing the cooperation of all landowners within the area. Conservation agreements should be negotiated with landowners to ensure long-term habitat protection and access for management activities. Restoration of the Panaca Spring outflow stream and associated marsh may require modification of irrigation delivery systems. Private land parcels may also be acquired in fee title from willing sellers.

1.2.2. Obtain instream flow water rights

If research indicates that the existing instream flow water right granted to The Nature Conservancy is inadequate for meeting the needs of Big Spring spinedace and other aquatic species native to the Condor Canyon reach of Meadow Valley Wash, additional nonconsumptive, instream flow water rights should be obtained. The ground water system supporting the springs in the Condor Canyon segment of Meadow Valley Wash should also be protected.

1.2.3. Implement Condor Canyon HMP

BLM's Condor Canyon HMP includes objectives, planned actions, and facilitating actions which, when implemented, should protect Big Spring spinedace habitat on land managed by BLM. These actions include, among others, formal relinquishment of the Union Pacific Railroad Company right-of-way back to BLM, prohibition on drilling water wells on public lands if the action will lessen Meadow Valley Wash stream volume, restriction of livestock use in riparian areas, and management of all

habitat on public land occupied by Big Spring spinedace as if it were designated critical habitat.

1.2.4. Amend Big Spring spinedace critical habitat

The existing critical habitat designation for Big Spring spinedace does not include the perennial portion of Meadow Valley Wash immediately north of Condor Canyon, which currently supports the majority of the population. Critical habitat also does not include the outflow stream from Panaca Spring. If research identifies that the existing designated critical habitat does not contain all habitat essential to the recovery of the species, then Big Spring spinedace critical habitat should be amended to include all essential habitat.

1.2.5. Develop nonnative aquatic species control plan

A plan should be developed to guide efforts to remove or control individuals or populations of nonnative aquatic species to prevent or minimize predation on and/or competition with Big Spring spinedace and the other native fish species. The plan should recommend control levels and methods appropriate to the impact of the nonnative species on the native fauna. Any recommended eradication methods should fully consider the direct and indirect effects of the action on the entire aquatic ecosystem. The plan should also address prevention of immigration of nonnative fish species from upstream reservoirs.

1.2.6. Implement nonnative aquatic species control plan

Once the nonnative aquatic species control plan has been developed, it should be implemented.

1.3. Enhance Big Spring spinedace population and its habitat

Recovery of Big Spring spinedace requires the maintenance of a self-sustaining population of the species. Efforts should be undertaken to maintain genetic viability of the population. If the population viability analysis identified in task 1.1.3. determines that the existing Big Spring spinedace population is not large enough to ensure its survival into the future, efforts should be undertaken to correct limiting factors and allow the population to expand both in size and distribution.

1.3.1. Develop a genetic maintenance plan for Big Spring spinedace

The Big Spring spinedace population is currently separated into two units by a waterfall. Transfer of genetic material may only occur in one direction, from upstream of the waterfall to downstream. A plan should be developed to address maintenance of the genetic integrity of the population. The genetic characteristics of Big Spring spinedace existing both above and below the Condor Canyon waterfall should be evaluated and compared to preserved specimens. The results of the genetic evaluation should be used as the basis for recommendations regarding future management of the Condor Canyon population.

1.3.2. Implement genetic maintenance plan

Once the genetic management plan has been developed, it should be implemented.

1.3.3. Develop a habitat rehabilitation plan for Condor Canyon

If certain aspects of existing habitat conditions within Condor Canyon are determined to be limiting the size and distribution of the Big Spring spinedace population, a habitat rehabilitation plan should be developed which outlines actions necessary to correct the problems. The plan should identify the extent and character of habitat necessary to support a self-sustaining population of Big Spring spinedace and management strategies necessary to maintain optimum habitat conditions in the long-term. The plan should also evaluate the potential to restore habitat in Meadow Valley Wash, from the south end of Condor Canyon to the marsh created by the outflow stream from Panaca Spring, to a condition suitable to support Big Spring spinedace. If feasible, restoration of this segment of stream would allow Big Spring spinedace to recolonize historic habitat. The habitat restoration plan could be developed as an amendment to, or independent of, the BLM's Condor Canyon HMP, because management actions may include habitat on private and public land. The plan should be based on the most recent data available on Big Spring spinedace, flexible enough to be modified as new data are acquired, and consider the effects of management activities on all native species.

1.3.4. Implement habitat rehabilitation plan

Once the habitat rehabilitation plan has been developed, it should be implemented.

1.4. Monitor Big Spring spinedace population

The stability and health of the Big Spring spinedace population can only be assessed by regular monitoring to determine population size, age-class structure, and distribution. Regular monitoring will also provide information on the effect of habitat improvements on the Big Spring spinedace populations, such as the species expansion into unoccupied reaches and the occurrence and abundance of coexisting native and nonnative species. Habitat quality and quantity should also be evaluated regularly. Information collected during monitoring can identify potential problems in a timely manner, guide management activities, and permit an analysis of the effectiveness of recovery programs. Ultimately, this information will be used to determine whether or not recovery has been accomplished.

1.4.1. Develop a Big Spring spinedace population monitoring plan

A population monitoring plan should be developed which identifies the information to be collected, monitoring techniques, time-frames, etc.

1.4.2. Implement population monitoring plan

Once the population monitoring plan has been developed, it should be implemented.

1.5. Establish a public outreach program

Recovery of Big Spring spinedace may require modifications of current management and use of private and public lands. An effective public-outreach program can prevent negative public sentiment regarding the entire recovery process and thereby create an avenue for rapid accomplishment of recovery tasks.

1.5.1. Develop a public-outreach program

A public-outreach program should be developed to inform local governments, residents, management agencies, and other interested parties of Big Spring spinedace recovery efforts. Interested parties should be continually involved in and updated on all aspects of this recovery effort so that conflicts can be avoided as much as possible. Appropriate information relative to the status of Big Spring spinedace and the ongoing recovery effort should be provided for release via newspapers, television, radio, etc.

1.5.2. Implement the public-outreach program

Once the program has been developed, it should be implemented. Certain aspects of public outreach may need to be addressed prior to completion of a formal program.

2. Establish refugia populations

Only one population of Big Spring spinedace is known to currently exist or to have existed in the past. This species is vulnerable to catastrophic natural or human-induced habitat perturbations which may eliminate or severely reduce the entire population. One or more self-sustaining refugia populations should be established to minimize the threat of extinction due to unforeseen catastrophic events.

2.1. Select suitable refugia habitat

Information collected on life history and habitat requirements should be utilized to evaluate potential refugia sites. Selection of suitable habitats should consider existing habitat conditions, aquatic species composition, land and water uses, landownership, maintenance requirements, and other potential conflicts. Suitable habitats must be of sufficient size to support a self-sustaining population of Big Spring spinedace, and conflicts must be resolvable.

2.2. Secure selected refugia habitat

Cooperation of all landowners and/or Federal land management agencies within the introduction area must be secured to ensure continuous and consistent protection of the habitat. Conservation agreements should be negotiated with landowners to ensure habitat protection and access for management activities. Private land parcels and/or appurtenant water rights may be acquired in fee title from willing sellers. Non-consumptive instream flow water rights should be obtained to ensure sufficient instream flow to meet the needs of Big Spring spinedace. The ground water system which supports each habitat should also be protected.

2.3. Develop habitat rehabilitation plan for refugia

A habitat rehabilitation plan should be developed for each Big Spring spinedace refugia. The plans should identify existing habitat conditions, the extent and character of habitat necessary to support a self-sustaining population of Big Spring spinedace, any improvements necessary to enhance the habitat, and management strategies necessary to maintain optimum habitat

conditions in the long-term. The plan should be based on the most recent data available on Big Spring spinedace, be flexible enough to be modified as new data are acquired, and consider the effects of management activities on all endemic species.

2.4. Implement habitat rehabilitation plans

Once the habitat rehabilitation plans are developed, they should be implemented.

2.5. Develop Big Spring spinedace introduction plan

An introduction plan should be developed to ensure that the introduction of Big Spring spinedace refugia is adequately planned and properly implemented. The American Fisheries Society's "Guidelines for Introductions of Threatened and Endangered Fishes" (Williams, et al. 1988) provides a summary of issues to address. The plan should identify the source of Big Spring spinedace for introduction, number of fish needed to establish a new population, and methods of transport and release. If the Condor Canyon population is the source of fish, the plan should identify the number of Big Spring spinedace that can be removed at any one time without adversely affecting the source population. If the fish are to be produced through a captive propagation program, the plan should adhere to the Service's most recent guidelines on captive propagation of threatened and endangered fishes. Selection of fish to release and timing of the release should take into consideration reproduction potential and natural mortality factors. The Big Spring spinedace released into the refugia should be free of undesirable parasites and diseases to prevent their spread. Additionally, mortality of transplanted fishes has been attributed

to the activation of latent infections or parasite infestations due to handling and other stress-related factors. The introduction plan should include guidelines for managing the genetics of each Big Spring spinedace refugia. Several releases may be necessary to establish each population. Population establishment may not be realized for several years.

2.6. Implement introduction plan

Once the introduction plan has been completed and the refugia habitat is suitable, introduction of Big Spring spinedace should proceed.

2.7. Develop refugium population monitoring plan

The success of efforts to establish Big Spring spinedace refugia populations can only be evaluated by regular monitoring to determine population size, age-class structure, and distribution. Habitat quality and quantity should also be evaluated regularly. Information collected during monitoring can identify potential problems in a timely manner and guide refugium management activities. A refugium population monitoring plan should be developed which identifies the information to be collected, monitoring techniques, time-frames, etc.

2.8. Implement refugium population monitoring plan

Once the refugium population monitoring plan has been developed, it should be implemented.

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Part III. IMPLEMENTATION SCHEDULE

This implementation schedule outlines recommended actions and estimated costs associated with the recovery of Big Spring spinedace. It is a guide for meeting the objective discussed in Part II of this recovery plan. This schedule indicates task priorities, numbers, and descriptions; duration of each task; responsible agencies; and estimated costs. These actions, when accomplished, should bring about the recovery of Big Spring spinedace and protect its habitat. Estimated monetary needs for all parties involved in recovery are identified and, therefore, this schedule reflects the total estimated financial requirements for the recovery of this species.

In the implementation schedule, tasks are arranged in priority order. The assigned priorities are defined as follows:

Priority 1 - An action that *must* be undertaken to prevent extinction or to prevent Big Spring spinedace from declining irreversibly in the *foreseeable* future.

Priority 2 - An action that *must* be undertaken to prevent a significant decline in Big Spring spinedace population distribution or size, or habitat quality, or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to meet the recovery objective.

The following abbreviations are used in the implementation schedule:

Task Duration

Cont.	=	The action will be implemented continually once begun.
Ongoing	=	Currently being implemented and will continue until no longer necessary for recovery.

Responsible Party

*	=	Lead Agency
BLM	=	U.S. Bureau of Land Management

FWS-ES	=	U.S. Fish and Wildlife Service, Division of Ecological Services
NDOW	=	Nevada Department of Wildlife
Total Cost	=	Projected cost of task from start to finish.
TBD	=	To Be Determined at a later date

IMPLEMENTATION SCHEDULE FOR THE BIG SPRING SPINEDACE RECOVERY PLAN (1994 – 1998; Total Cost = Sum of costs through 2006)

Priority Number	Task Number	Task Description	Task Duration (Years)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
1	1.2.1.	Obtain conservation agreements	4	FWS–ES*	12	3	3			3
				NDOW	4	1	1			1
1	1.2.2.	Obtain instream water rights	2	FWS–ES*	TBD					TBD
				NDOW	TBD					TBD
				BLM	TBD					TBD
		Cost Need 1: (Secure Condor Canyon habitat)			16	4	4	0	0	4
1	1.4.1.	Develop population monitoring plan	1	NDOW*	2	2				
				FWS–ES	1	1				
1	1.4.2.	Implement population monitoring plan	Cont.	NDOW*	TBD		TBD	TBD	TBD	TBD
				FWS–ES	TBD		TBD	TBD	TBD	TBD
		Cost Need 2: (Monitor Condor Canyon population)			3	3	0	0	0	0
1	1.1.1.	Determine life history requirements	3	FWS–ES*	30	10	10	10		
				NDOW	6	2	2	2		
1	2.1.	Select suitable refugia sites	3	FWS–ES*	6				2	2
				NDOW	3				1	1

IMPLEMENTATION SCHEDULE FOR THE BIG SPRING SPINEDACE RECOVERY PLAN (1994 – 1998; Total Cost = Sum of costs through 2006)

Priority Number	Task Number	Task Description	Task Duration (Years)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
				Total Costs:	196	44	46	32	16	13

IMPLEMENTATION SCHEDULE FOR THE BIG SPRING SPINEDACE RECOVERY PLAN (1994 – 1998; Total Cost = Sum of costs through 2006)

Priority Number	Task Number	Task Description	Task Duration (Years)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
				BLM	3				1	1
1	2.2.	Secure selected refugia habitat	3	FWS–ES*	TBD					TBD
				BLM	TBD					TBD
1	2.3.	Develop refugia habitat rehabilitation plans	2	FWS–ES*	4					
				BLM	2					
1	2.4.	Implement habitat rehabilitation plan	TBD	FWS–ES*	TBD					
				BLM	TBD					
1	2.5.	Develop refugia introduction plan	1	NDOW*	2					
				FWS–ES	1					
1	2.6.	Implement introduction plan	TBD	NDOW*	TBD					
				FWS–ES	TBD					
1	2.7.	Develop refugium population monitoring plan	1	NDOW*	2					
				FWS–ES	1					
1	2.8.	Implement refugium population monitoring plan	Cont.	NDOW*	TBD					
				FWS–ES	TBD					
		Cost Need 3: (Establish Big Spring spinedace refugium)			60	12	12	12	4	4

IMPLEMENTATION SCHEDULE FOR THE BIG SPRING SPINEDACE RECOVERY PLAN (1994 – 1998; Total Cost = Sum of costs through 2006)

Priority Number	Task Number	Task Description	Task Duration (Years)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
2	1.1.2.	Determine species interactions	3	FWS–ES* NDOW	12 3	4 1	4 1	4 1		
2	1.1.3.	Conduct population viability analysis	1	FWS–ES*	10				10	
2	1.3.1.	Develop genetic maintenance plan	2	NDOW* FWS–ES	7 2		5 1	2 1		
2	1.3.2.	Implement genetic maintenance plan	Cont.	NDOW* FWS–ES	TBD TBD			TBD TBD	TBD TBD	TBD TBD
		Cost Need 4: (Enhance Condor Canyon population)			34	5	11	8	10	0
2	1.1.4.	Determine Condor Canyon ecosystem components	3	BLM* FWS–ES	24 6	8 2	8 2	8 2		
2	1.2.3.	Implement Condor Canyon HMP	Ongoing	BLM*	26	2	2	2	2	2
2	1.2.5.	Develop nonnative species control plan	2	NDOW* FWS–ES	4 2	2 1	2 1			
2	1.2.6.	Implement nonnative species control plan	Cont.	NDOW* FWS–ES	TBD TBD		TBD TBD	TBD TBD	TBD TBD	TBD TBD

IMPLEMENTATION SCHEDULE FOR THE BIG SPRING SPINEDACE RECOVERY PLAN (1994 – 1998; Total Cost = Sum of costs through 2006)

Priority Number	Task Number	Task Description	Task Duration (Years)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
2	1.3.3.	Develop habitat rehabilitation plan	2	BLM*	4					
				FWS–ES	2					
2	1.3.4.	Implement habitat rehabilitation plan	TBD	BLM*	TBD					
				FWS–ES	TBD					
3	1.2.4.	Amend critical habitat	2	FWS–ES*	6					3
		Cost Need 5: (Enhance Condor Canyon habitat)			74	15	15	12	2	5
3	1.5.1.	Develop public–outreach program	2	FWS–ES*	5	3	2			
				BLM	2	1	1			
				NDOW	2	1	1			
3	1.5.2.	Implement public outreach program	Cont.	FWS–ES*	TBD		TBD	TBD	TBD	TBD
				BLM	TBD		TBD	TBD	TBD	TBD
				NDOW	TBD		TBD	TBD	TBD	TBD
		Cost Need 6: (Implement public outreach program)			9	5	4	0	0	0

Part IV. APPENDIX

A. Review of the Technical/Agency Review Draft of the Big Spring Spinedace Recovery Plan

The Technical/Agency Review Draft of the Big Spring Spinedace Recovery plan was made available to the public for comment as required by the 1988 amendments to the Endangered Species Act of 1973, as amended. The public comment period was announced in the Federal Register on December 31, 1992, and closed on March 1, 1993. The Service solicited comments on the document from the individuals and/or agencies identified below. During the 60-day comment period, the Service received 10 response letters from individuals denoted with an asterisk (*) on the list below. The comments provided in these letters were considered in preparation of this final recovery plan and incorporated as appropriate.

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